

present the moniliform aspect so frequent in the Annelida. In this region it is surrounded by a sort of muscular sphincter belonging to the septum; elsewhere it presents the ordinary longitudinal and transverse muscular coats. Its internal epithelium, of a green colour, is very strongly vibratile throughout its whole extent from the mouth to the anus. The circulatory apparatus is composed of a dorsal vessel bifurcating in front at the level of the vibratile pits, but also emitting a little lower down two oblique branches directed forwards and joining the vertical branches resulting from the bifurcation. In each ring the dorsal vessel emits a lateral loop; and all these loops seemed to me to terminate in a median ventral vessel. The vascular apparatus of *Polygordius Villoti* is therefore more complicated than that of its congeners, in which there is no ventral vessel and the lateral loops terminate caecally.

The genital elements are developed on the walls of the body and of the longitudinal partitions in all the rings behind the first four or five. They are free in the general cavity, where in the males the tails of the spermatozooids may be seen floating and stirring about like a sort of vibratile lining, when the heads are still united in a single group soldered to the walls of the cavity. The heads of the spermatozooids are pointed at the pole opposite the tail; they afterwards swell out into a sphere, and then enlarge a little, so as to form a sort of disk, from the centre of which springs the tail. Spermatozooids of this form have been figured in some Annelides. The ova have a vitellus of an orange colour, and often several germinal spots; they cause the female to be of a more decidedly reddish colour than the male. The evacuation of the products of generation is effected by the intermediation of segmentary organs, which are but little folded upon themselves, and vibratile throughout their length.

By these various characters *Polygordius Villoti*, as may be seen, approaches very near to the Annelida; but the absence of locomotive setæ, and the presence of vibratile pits on each side of the head, would tend to approximate it to the Nemertians, from which, however, it is excluded by the absence of vibratile cilia on the integument and the distinctness of the septation. I see no character which justifies at all clearly the approximation of *Polygordius Villoti* to the Nematodes.

I propose to resume shortly the researches which I have commenced on this interesting type; their results will appear in the 'Archives de Zoologie expérimentale' of Professor de Lacaze-Duthiers.—*Comptes Rendus*, April 26, 1875, p. 1101.

*On the Development of the Spinules in the Scales of Gobius niger (Linn.).*

By M. L. VAILLANT.

The theories admitted by anatomists with regard to the origin of the spinules may be divided into two principal ones: either these processes result from simple notchings of the posterior margin of the scale, and being calcified with the lamella are only a dependence

thereof, as supposed by Agassiz and also by Baudelot; or else these parts are developed at the expense of a special blastema as a kind of teeth, the opinion maintained by M. Mandl. Although this latter view is generally abandoned, the following observations show that it may be regarded as correct, at least in certain fishes.

*Gobius niger* (Linn.), very common on our coasts, has furnished me with the materials for these researches. Its scales, of which M. Baudelot has given a very good description, are of a very simple type, never having more than a single row of spinules on the posterior margin of the concentrically ribbed lamella. This lamella may even exist alone, either all over the body, as in very young individuals, or only on the ventral parts, as in the adult.

In the complete scales the lamella shows a nearly quadrilateral form, the anterior side being rounded, and the posterior side slightly projecting and angular. The number of marginal notches seems never to exceed nine or ten. The focus, which is usually small and circular, is marginal, approaching the posterior margin; the concentric crests are numerous. The epithelium, in which the pigmentary layer is distinct, clothes all the posterior part of the scale and forms a festoon-like marginal mass, in which the spinules are entirely imbedded. The latter appear in an order well described by authors—that is to say, commencing with a median spinule, then lateral pairs; at least this is what anatomical examination leads us to suppose, which always shows the spinules unpaired in number when there are not more than seven; beyond this it is not rare to find an even number, which may no doubt be attributed to the unequally rapid development of the lateral spinules. The observations related here may explain these facts. The length of the spinules differs at the centre and at the sides, of course only taking into consideration the completely developed spinules. The former are sensibly shorter, and the size regularly increases to the spinules nearest the angles; so that all the points, without coming to the same straight line, form an angle a little more open than that of the posterior margin of the lamella; only the point of the spinules projects slightly beyond the epithelium, which shows at this point particularly well the pigmentary masses distributed in two layers—the first bordering the lamella at the base of the spinules, and the second formed of usually isolated chromoblasts placed in the interspinular spaces all at the same level, producing a very elegant design.

The epithelial cells, it is very important to notice, are of extreme delicacy; simple contact with the sea-water, even only for ten minutes, swells them, breaks them up, and transforms the whole into a magma in which it becomes impossible to detect the relations of the parts. To repeat the observations it is absolutely necessary to have a fish not only fresh but living; in this respect *Gobius niger* is a particularly favourable species, as it may be preserved several days with very little trouble in a very small quantity of sea-water. As soon as the scale is taken off it ought to be placed quickly under the microscope to examine it at once; if it be desired to continue the observation, the tissues must be hardened immediately by the

use of reagents, such as alcohol, solutions of chromic acid, picric acid, &c. By these means the preparations are preserved so well that, with precautions, they may be mounted in Canada balsam.

Under suitable conditions, on nearly all the scales there will be found, outside the perfect spinules, two of these organs, one on each side, in course of development; and by multiplying the observations, we may form a clear idea of the origin of these parts.

In the most rudimentary state that I have been able to observe, the spinule is reduced to a sort of flattened cone, 0.03 millim. in diameter at its base, and of about the same height. It is surrounded by cells measuring from 0.009 to 0.014 millim., resembling the other epithelial elements in their aspect and dimensions, but distinguished from them nevertheless by their arrangement in a more or less spherical mass. The cone is composed of a very finely granular substance, especially after the action of certain reagents, such as acetic acid; it must be regarded as intended to furnish the materials necessary for the growth of the spinule—in fact as the *spinular papilla*, the spherical mass representing a true *follicle*.

A little later the follicle becomes less distinct, and even disappears completely; at the same time the other parts become more complicated. The papilla always remains in the same state, and nearly in the same form; but its point is as it were hooded by a transparent hyaline sheath, the first rudiment of the dentinous substance which will form the perfectly developed organ. At this time, if the preparation is treated with acetic acid, the tissue of the papilla becomes granular, while the sheath becomes pale; no effervescence or sensible diminution of volume is observed, which must be attributed to the small quantity of calcareous matter which the tissue then contains compared with the abundance of the organic part.

The development is continued to the complete state by the gradual augmentation of the dentinous cone. One of the first effects is to hide the papilla; then the point lengthens, and ends by piercing the epidermic festoon.

The papilla seems to persist even in the perfectly developed spinules. On treating the scale with a strong acid (such as hydrochloric or nitric acid) to get rid of the calcareous salts, we see the aspect of the spinules become greatly modified. The length becomes scarcely half that of the entire organ; the granular substance constituting the papilla appears in the form of a sort of basal bud, produced, towards the free margin of the epidermic mass, by a cylinder formed of the same substance. In the young spinules the papilla alone remains; in the perfect spinules the cylindrical prolongation is hooded by the organic substance of the decalcified dentine, persisting under the appearance of a transparent, elastic, hyaline layer, in which a sort of fibrous longitudinal structure may be made out. Under the action of the reagent, and in consequence of the disengagement of carbonic acid, this gas is very often accumulated under the epidermis, between the lamella and the row of spinules, and separates them, putting the discontinuity of these parts beyond a doubt.

The study of these facts leads, in the first place, to the conclusion that in these animals the spinules and the lamella are developed independently of each other; and if we take into consideration the relations of these parts to the surrounding tissues, the former belong to the epidermis, and the latter to the deeper part of the integuments—that is to say, to the dermis. Secondly, if we consider these organs in the whole of the class of Fishes, we are led to regard the scales of these Ctenoids as a sort of intermediate type. In the eel, in *Rypticus*, *Grammistes*, and certain Blennioidei the scale, reduced to the lamella, is subepidermic and destitute of spinules: in the sharks and rays the hard portions of the integuments have quite another origin; they are epidermic. It will therefore be legitimate in *Gobius* and analogous fishes to compare the lamella to the deep-seated scale of the eel, and the free spinules to the scutella of the Plagiostomi.—*Comptes Rendus*, July 19, 1875, p. 137.

*On the Larval Forms of the Bryozoa.*

By M. J. BARROIS.

To the type represented by *Alcyonidium* may be referred a numerous series, the whole of which constitute our *first larval form*. In all the representatives of two great divisions of the Bryozoa, the Chilostomata and the Ctenostomata (*Alcyonidiina* and *Vesiculariæ*), the development presents, as in *Alcyonidium*, three principal phases:—1, segmentation to the thirty-two stage; 2, formation of the *gastrolula*, and production of the *bell-shaped stage*; and, 3, histological differentiation and completion of the organs.

The first two phases are identical throughout, and the bell-shaped stage is always reproduced with the same regularity. The third stage, on the contrary, may differ according to the genera, and the greater or less importance of the changes produced in it; we pass through all states of transition, from the most simple forms, as nearly as possible representing the bell-shaped stage in a permanent state, as in *Alcyonidium*, to the most complex and aberrant types. It is among these last that we must place *Cyphonautes* and the larvæ of the *Vesiculariæ*, which we shall take here as examples of forms thus modified.

The phenomena which occur in *Cyphonautes* during the third stage of development, after the bell-shaped stage, may be reduced to two fundamental processes:—

1. The furrow which will form the disk, instead of being produced in the middle of the dorsal surface, is produced near the summit, from which results a considerable reduction of that organ and a corresponding extension of the uniting membrane, which thenceforward forms the greater part of the dorsal surface.

2. The ventral surface tends to become invaginated inwards, and the crown to begin to close above by applying to each other its two opposite margins; in this way the vestibule and the bilateral form